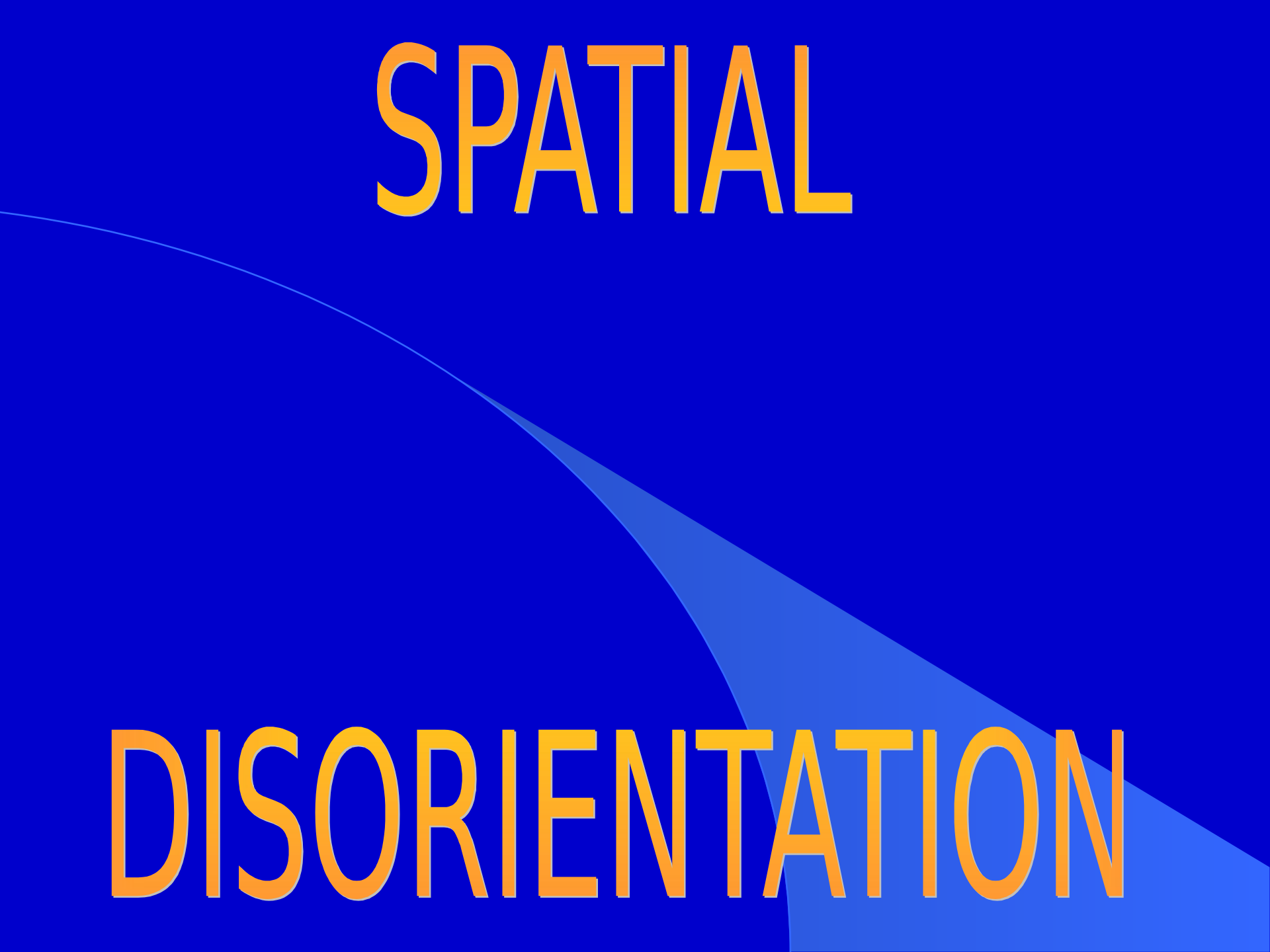


The background is a solid blue color. A light blue, curved, wedge-like shape originates from the left side and extends towards the bottom right corner, creating a sense of movement or a spotlight effect.

# SPATIAL

# DISORIENTATION

# Terminal Learning Objective

ACTION: Identify normal orientation,  
the  
nature of spatial  
disorientation,  
and associated illusions.

CONDITION: While serving as an  
aircrew  
member

STANDARD: In Accordance With (IAW)

SAFETY REQUIREMENTS: None

RISK ASSESSMENT LEVEL: Low

ENVIROMENTAL CONSIDERATIONS: None

# Enabling Learning Objective A

ACTION: Identify the terminology  
associated  
with spatial disorientation.

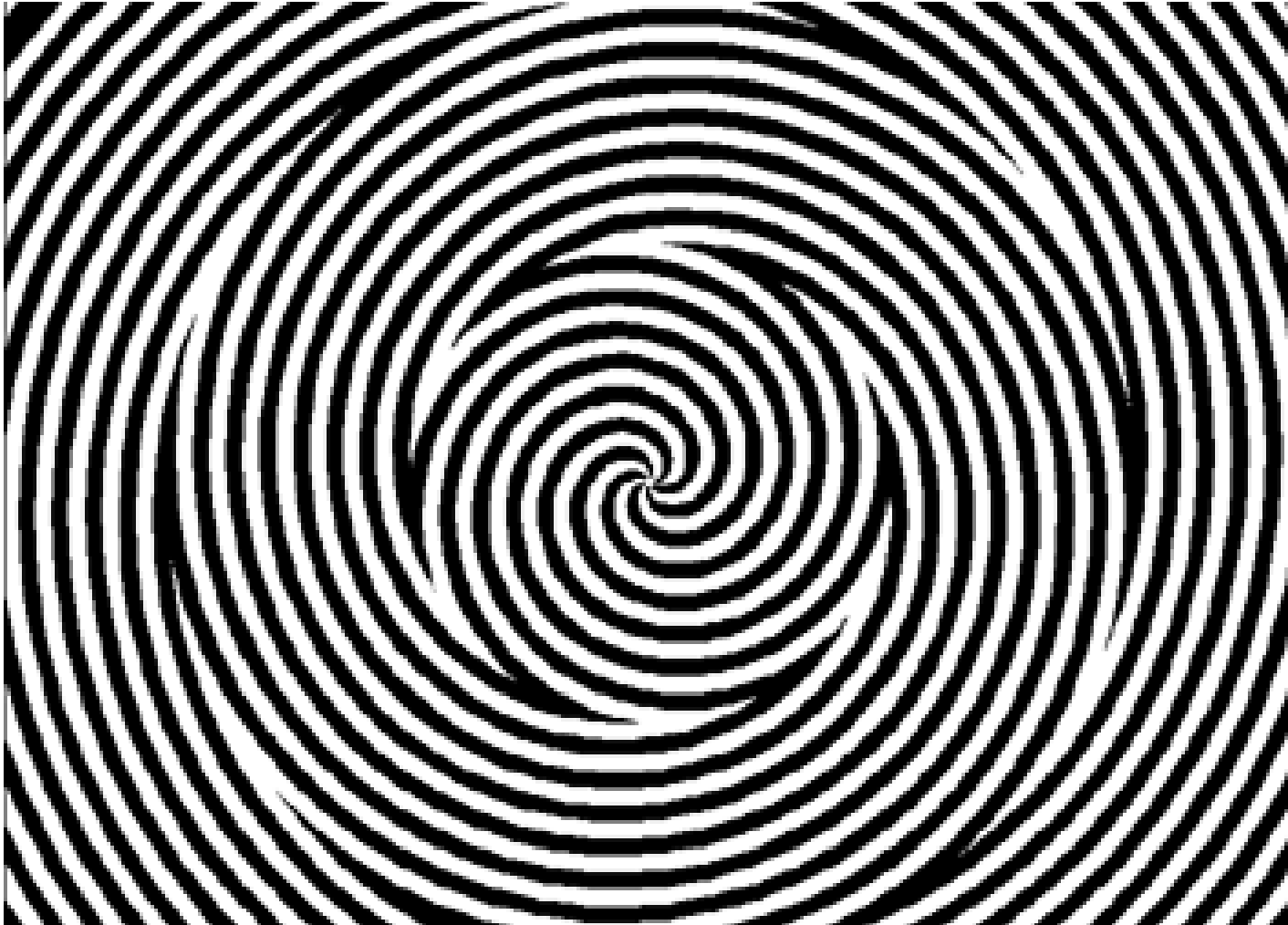
CONDITION: Given a list

STANDARD: IAW The Fundamentals of  
Aerospace Medicine and  
FM  
3-04.301

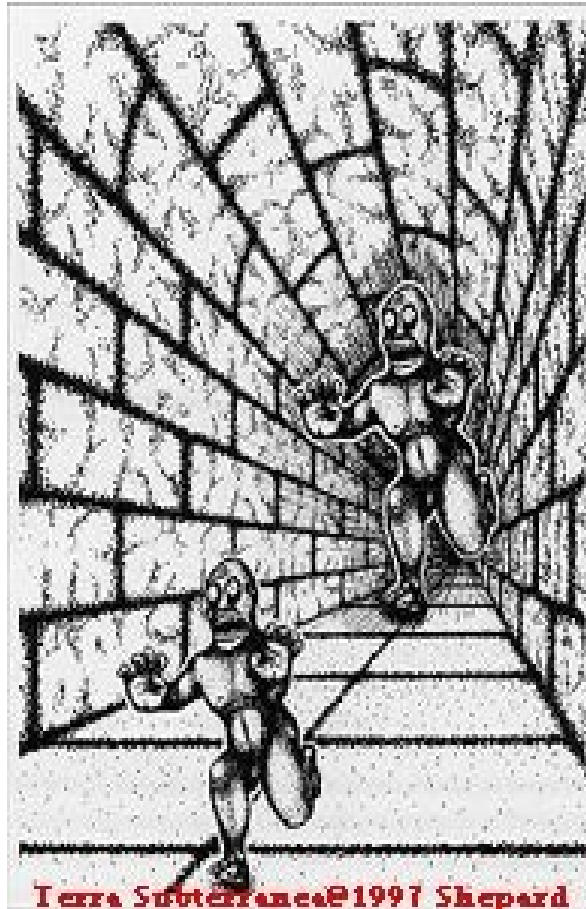
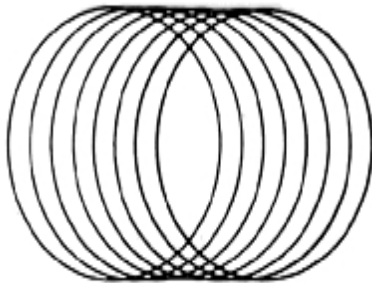
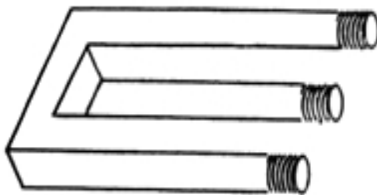
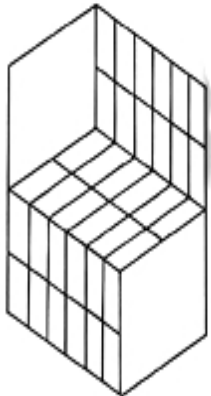
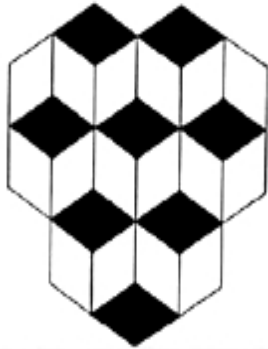
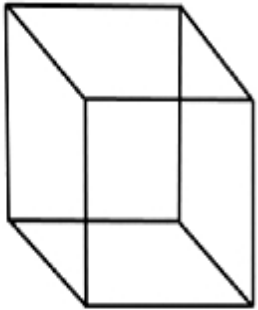
# TERMINOLOGY

- Vertigo
- Sensory Illusion
- Spatial Disorientation
- Orientation or equilibrium (balance)

# VERTIGO



# SENSORY ILLUSION



The background is a solid dark blue. A thin, light blue curved line starts from the top left and arcs towards the right. A larger, light blue wedge-shaped area is located on the right side, pointing towards the center.

# SPATIAL DISORIENTATION

# **Sensory Inputs that Provide Equilibrium**

**Visual**

**Vestibular**

**Proprioceptive**

➤ **ALL THREE SYSTEMS INTERGRATE TO FORM A COMPLETE MENTAL PICTURE**



# Enabling Learning Objective B

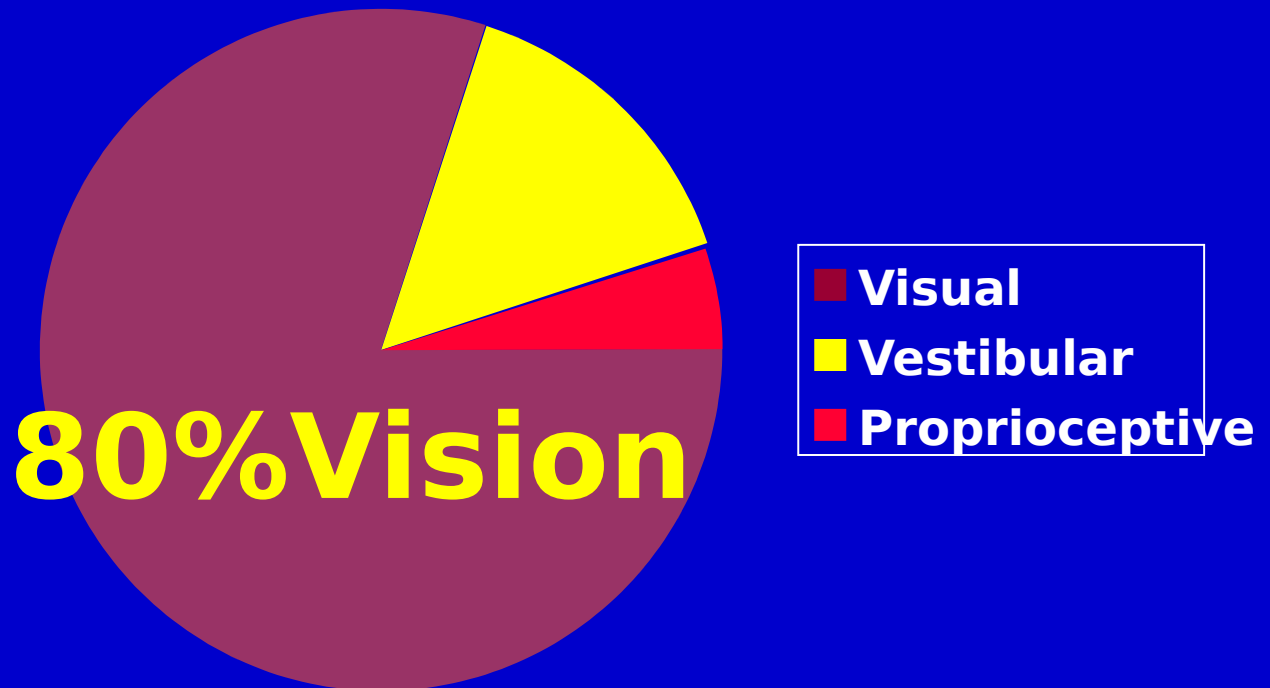
**ACTION:** Identify the role of vision in orientation.

**CONDITION:** Given a list

**STANDARD:** IAW The Fundamentals of  
Aerospace Medicine and FM  
3-04.301

# Role Of Vision

- **Vision is the most reliable sense used during flight**



# ROLE OF VISUAL CUES

- Orientation of vision requires:
  - ➔ Perception
  - ▢ Recognition
  - ▢ Identification
- Orientation can be achieved by individuals understanding where objects are in relation to themselves

# Visual System

➤ **The systems consists of two modes:**

**Focal (Central) vision (30 degrees)**

**Ambient (Peripheral) vision  
(175 degrees)**

# **Focal (Central) Vision**

- **Done consciously**
- **Presents us with clear view**
- **Allows us to view colors**
- **Determines distance and depth perception**

# AMBIENT VISION

- Also called Peripheral Vision
- Done subconsciously
- Detects motion and attitude cues
- Helps to provide balance
- Poor visual acuity properties

# **Focal/Ambient Vision**

- **Operate independently**
- **Frequent transition between the two modes**

# CONDITIONS FOR SPATIAL DISORIENTATION

- The most predisposing condition for spatial disorientation is hovering at night with a lack of



# Enabling Learning Objective C

**ACTION:** Identify the visual illusions

**CONDITION:** Given a list

**STANDARD:** IAW The Fundamentals of  
Aerospace Medicine and  
FM  
3-04.301

# False Vertical/Horizontal Cues (False Horizon)

- Occurs when the pilot subconsciously chooses the wrong reference point for orientation

# Fascination/Fixation

➤ TASK SATURATION

➤ TARGET HYPNOSIS

# Flicker Vertigo

- Caused by sunlight flickering through rotor blades
- Rotating beacons reflecting against an overcast sky  
or against the windscreen

# Confusion with Ground Lights

- Along seashores or rural areas
- Ground lights may be perceived as celestial lights
- Celestial lights may be perceived as ground lights

# Relative Motion

- Falsely perceived self-motion in relation to the real motion of another object

# ALTERED PLANES OF REFERENCE

- Inaccurate sense of altitude, attitude, or flight path
- Mountains / Valleys

# Structural Illusion

The  
phenomenon  
in which  
objects  
become  
distorted  
when visual  
obscurants  
are present  
such as  
rain, snow,  
sleet, or the  
curvature of  
a  
wind

# HEIGHT/DEPTH PERCEPTION

- Due to a lack of visual cues, the pilots or crewmembers perceive that they higher than they actually are.

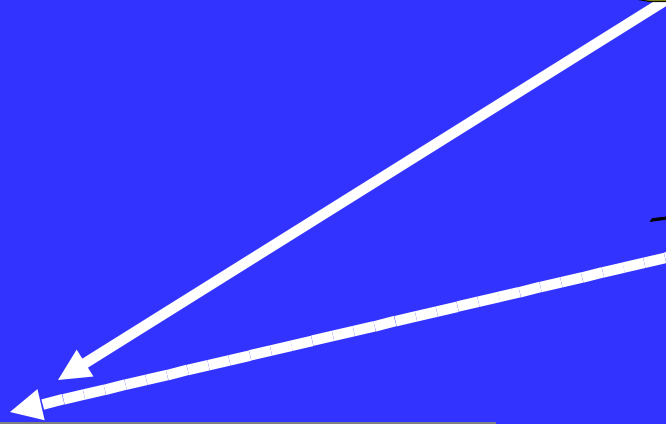
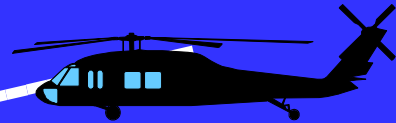
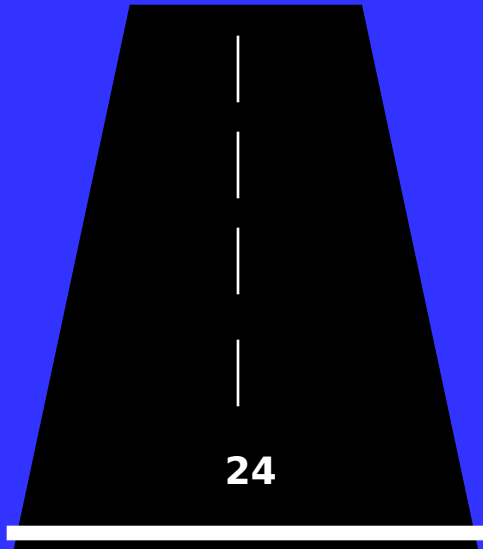
# Crater Illusion

## CRATER ILLUSION

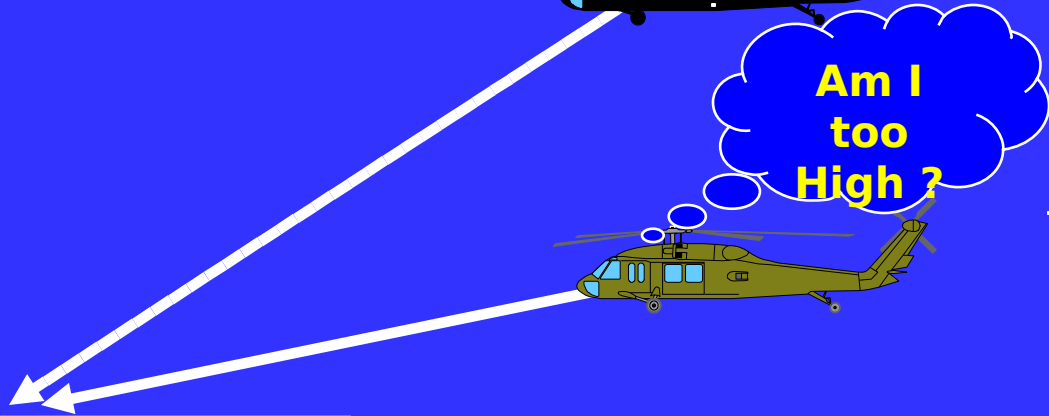
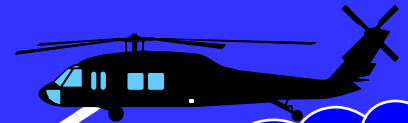
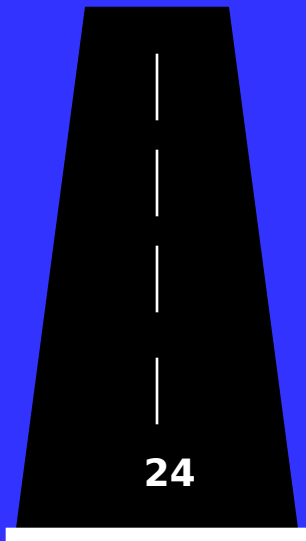
- An illusion that the aircraft is landing into a hole or crater, created when the search light is positioned too far under the nose of the aircraft

# Size- Distance Illusion

Large Wide Runway



Narrow Runway



# Autokinetic Illusion

- Occurs when a static light appears to move  
when it is stared at for several seconds

# REVERSABLE PERSPECTIVE

- At night, an aircraft may appear to be going away when it is actually approaching



uestions?

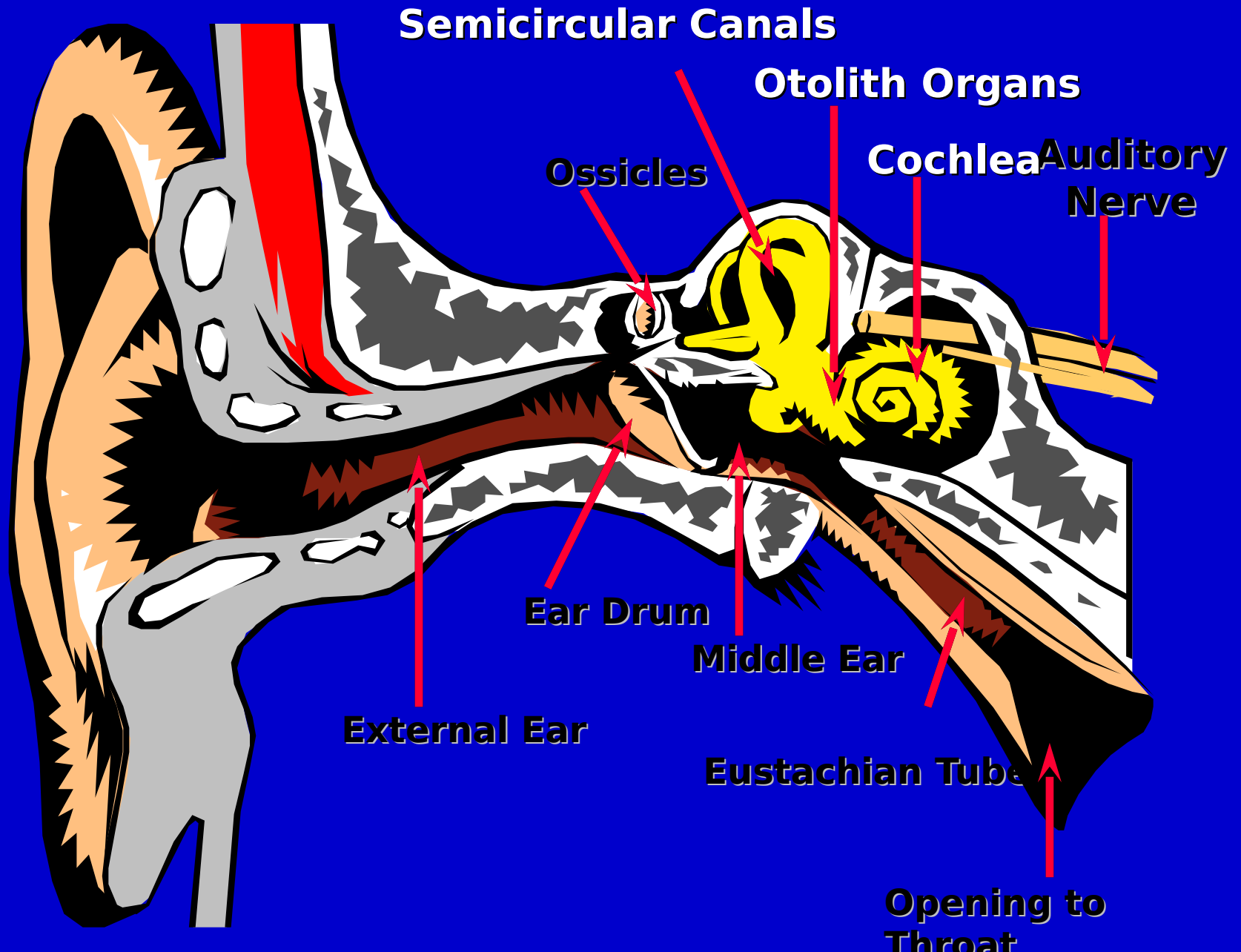
# Enabling Learning Objective D

ACTION: Identify the functions and components of the vestibular system.

CONDITION: Given a list

STANDARD: IAW The Fundamentals of  
Aerospace Medicine and  
FM  
3-04.301

# VESTIBULAR SYSTEM



# FUNCTIONS OF THE VESTIBULAR SYSTEM

- Visual tracking
- Reflex information
- Orientation without vision

# VISUAL TRACKING

- Maintains focus of the retinal image

# NYSTAGMUS

- A rapid flickering motion of both eyes back and forth, seriously degrading visual acuity to 20/200 for a few seconds



# ORIENTATION WITHOUT VISION

# COMPONENTS OF THE VESTIBULAR SYSTEM

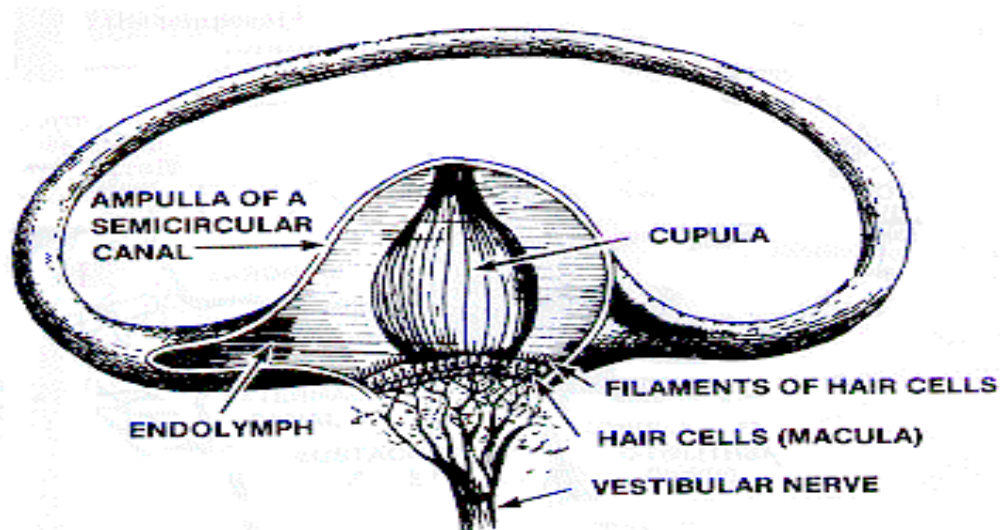
- Semicircular Canals
- Otolith Organs

# FUNCTIONS OF THE SEMICIRCULAR CANALS

- Responsive to angular acceleration and deceleration
- Change in both speed and direction
- Detects yaw, pitch, and roll

# SEMICIRCULAR CANALS

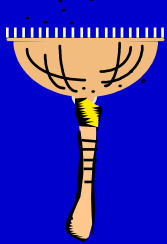
- Right angles to each other
- Contains endolymph fluid



# FUNCTION OF THE OTOLITH ORGANS

- The Otolith organs are stimulated by gravity and linear accelerations
- Change in speed without a change in direction
- Sensitive to linear acceleration and deceleration (forward, aft, up, and down)

# FUNCTION OF THE OTOLITH ORGANS



**UPRIGHT**  
TRUE SENSATION



**TILT FORWARD**  
TRUE SENSATION



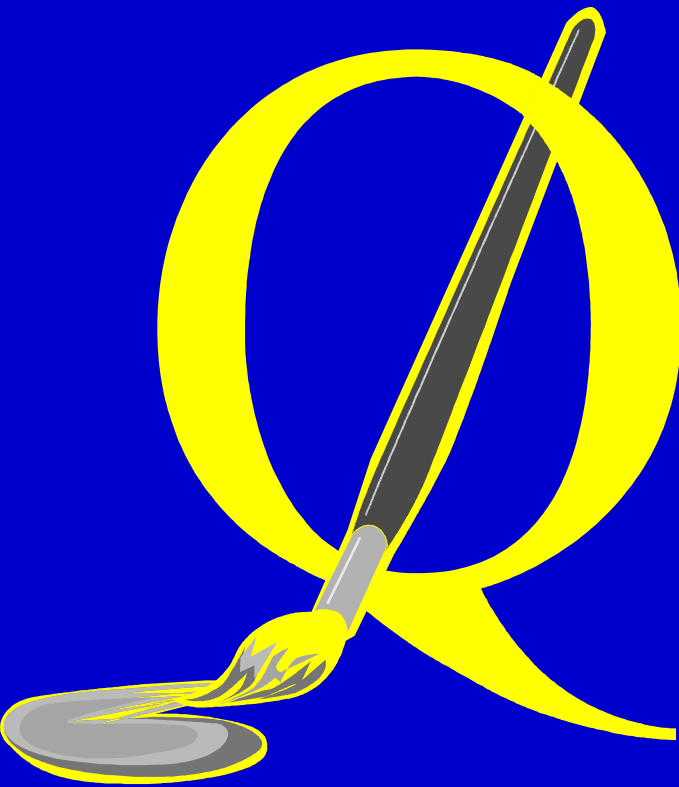
**TILT BACKWARD**  
TRUE SENSATION



**FORWARD ACCELERATION**  
**FALSE SENSATION OF BACKWARD**



**FORWARD**



uestions?

# Enabling Learning Objective E

ACTION: Identify vestibular illusions.

CONDITION: Given a list

STANDARD: IAW The Fundamentals of  
Aerospace Medicine and  
FM  
3-04.301

# VESTIBULAR ILLUSIONS

- Somatogyral: Semi-circular canals are stimulated by angular acceleration; a change in both speed and direction
- Somatogravic: Otolith organs are stimulated by linear acceleration; a change in speed without a change in direction

# **SOMATOGYRAL ILLUSIONS**

## **angular acceleration**

- The Leans
- Graveyard Spin
- Coriolis

# ***THE LEANS***

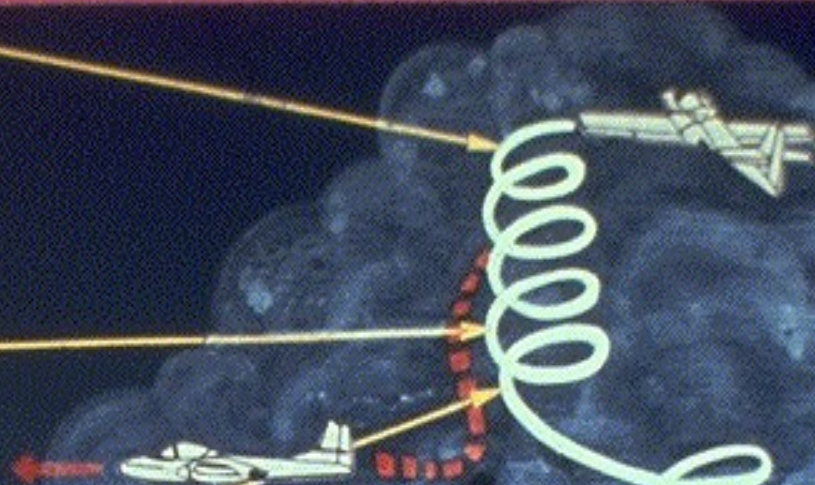
- Most common form of Spatial Disorientation

- Motion is usually undetected during a subthreshold maneuver (less than 2°)

Pilot corrects attitude and compensates for the false sensation of turning in the opposite direction

This illusion seldom affects both pilots at the same time

## THE GRAVEYARD SPIN/SPIRAL



PERCEIVED  
MOTION

ACTUAL  
MOTION

# CORIOLOIS ILLUSION

- Pilot enters a turn stimulating one semicircular canal
- Pilot makes a head movement in a different geometrical plane stimulating a second and/or third semicircular canal
- Results in overwhelming sensation of Yaw, Pitch, or Roll

# CORIOLOIS ILLUSION

- The most deadly illusion
- Likely to occur during instrument approach
- Most often unrecoverable

# SOMATOGRAVIC ILLUSION

(Linear/gravity dependent)

- Oculoagravic
- Elevator
- Oculogravic

# OCULOAGRAVIC

- Upward shift of gaze in eyes
- Instrument panel seems to move downward
- Giving the pilot a sense of “nose low” attitude
- Pilot will correct by pulling aft cyclic

# ELEVATOR ILLUSION

- Occurs during sudden upward acceleration
- Eyes gaze downward
- Instrument panel seems to rise
- Pilot perceives a nose up attitude
- Tendency to “nose over” aircraft

# OCULOGRAVIC ILLUSION

## Acceleration

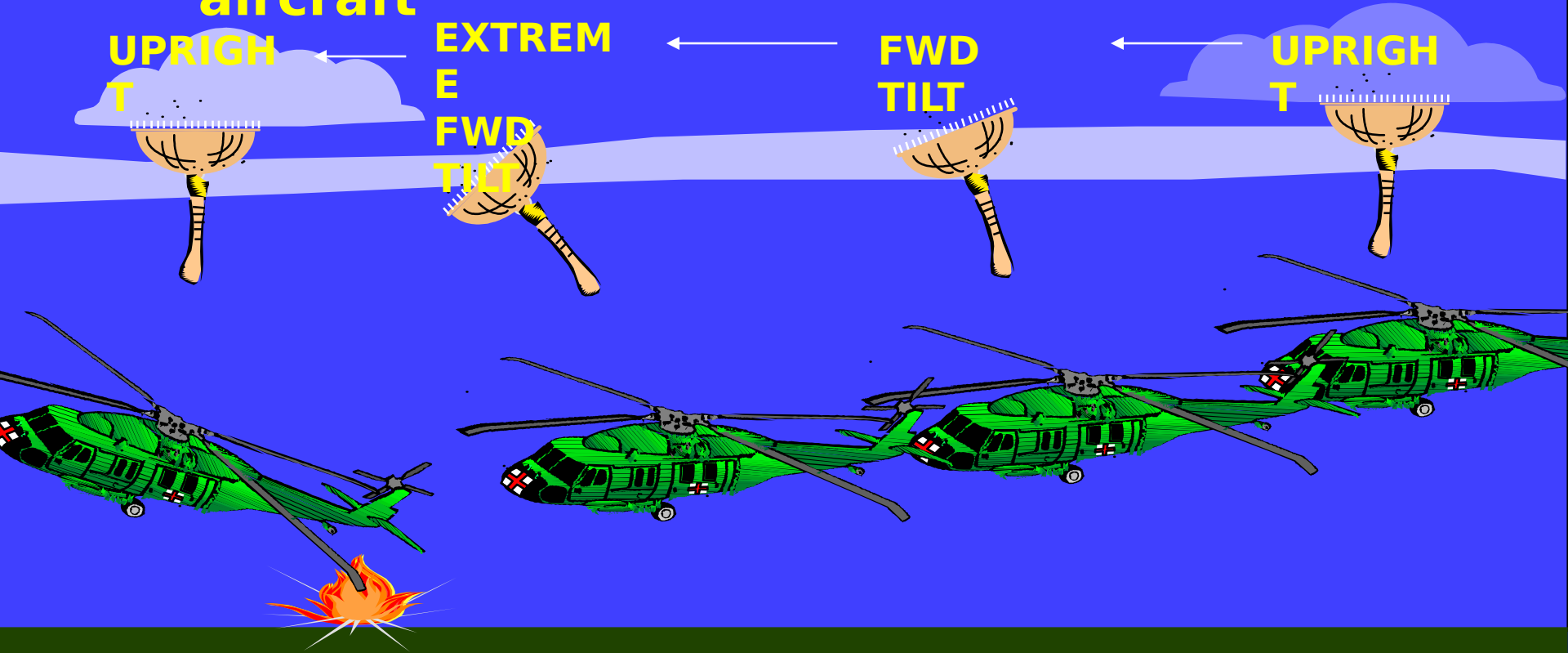
➤ Nose high attitude



# OCULOGRAVIC ILLUSION

## Deceleration

- Nose low attitude
- Most common in rotary wing aircraft





# Enabling Learning Objective G

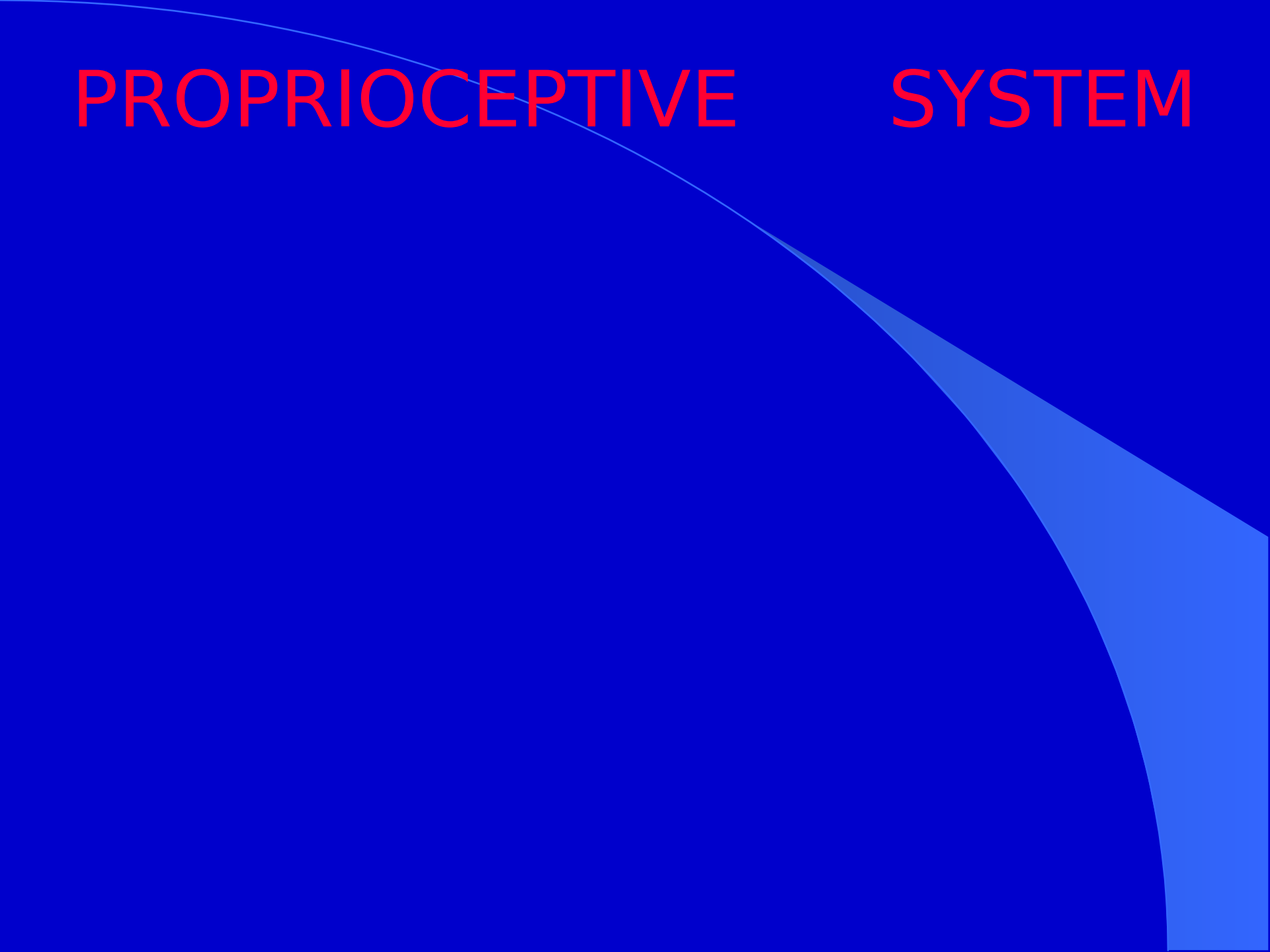
**ACTION:** Identify the proprioceptive mechanism of equilibrium.

**CONDITION:** Given a list

**STANDARD:** IAW The Fundamentals of Aerospace Medicine and FM 3-04.301

PROPRIOCEPTIVE

SYSTEM



# SEAT OF PANTS FLYING

- Very unreliable means of orientation
- Dependent upon gravity
- Flying without reference to instruments



# Enabling Learning Objective H

**ACTION:** Identify the classifications of spatial disorientation.

**CONDITION:** Given a list

**STANDARD:** IAW The Fundamentals of  
Aerospace Medicine and  
FM  
3-04.301

# TYPES OF DISORIENTATION

- TYPE I - UNRECOGNIZED
- TYPE II - RECOGNIZED
- TYPE III - INCAPACITATING

# UNRECOGNIZED Type I

- Pilot does not *consciously perceive* any indication of Spatial Disorientation
- False inputs from sensory organs or cues
- Crashes with smile on their face

# RECOGNIZED Type II

- Pilot *consciously perceives* a problem, but may not know it is due to spatial disorientation
- Pilot can correct the situation

# INCAPACITATING Type III

- Pilot experiences overwhelming sensations
- Conflict of sensory inputs
- Unable to properly orient themselves by use of instruments or visual cues



# Enabling Learning Objective I

ACTION: Identify the dynamics of spatial disorientation.

CONDITION: Given a list

STANDARD: IAW The Fundamentals of  
Aerospace Medicine and FM  
3-04.301

# DYNAMICS OF SPATIAL DISORIENTATION

- Visual dominance
- Vestibular suppression
- Vestibular opportunism

# VISUAL DOMINANCE

- A learned phenomenon where one incorporates visual orientation information while excluding other sensory cues (a very thorough cross-check)

# VESTIBULAR SUPPRESSION

- An active process of visually overriding undesirable vestibular sensations
- In flight, pilot develops suppression via repeated exposure to linear or angular acceleration

# VESTIBULAR OPPORTUNISM

- The ability of the vestibular system to fill any orientation void swiftly



# Enabling Learning Objective J

**ACTION:** Identify the measures to prevent spatial disorientation.

**CONDITION:** Given a list

**STANDARD:** IAW The Fundamentals of Aerospace Medicine and FM  
3-04.301

# SD PREVENTION

- Instruments-trust your instruments
- Cockpit management
- Education/training
- Instrument proficiency
- Aircraft design

# PREVENTION (cont.)

- Never fly without visual reference points
- Maintain situational awareness
- Never try to fly both VMC and IMC at the same time
- Avoid self-imposed stresses (DEATH)



# Enabling Learning Objective K

ACTION: Identify the corrective actions to treat spatial disorientation.

CONDITION: Given a list

STANDARD: IAW The Fundamentals of  
Aerospace Medicine and  
FM  
3-04.301

# TREATMENT

- Refer to instruments
- Develop and maintain cross-checks
- Delay intuitive reactions
- Transfer controls



**Ensure the  
Instruments  
Read Right**

- **Mechanisms of equilibrium**
- **Role of vision**
- **Visual illusions**
- **Function of Vestibular system**
- **Function of proprioceptive system**
- **Types of disorientation**
- **Dynamics of disorientation**
- **Prevention**
- **Treatment**